

Review of MFL for Lake Istokpoga
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Overview:

In general, I found the summary documentation to be thorough and well presented. Most chapters contained necessary information for adequately understanding the system being managed, the ongoing biological and ecological issues of concern, historical aspects of the Lake Istokpoga ecosystem, and current and future management plans and initiatives. It is clear that the staff has spent considerable time and energy on the development of the document, and the result is a report that is comprehensive and, in most cases, scientifically defensible. In this review I summarize the main points of each chapter and provide specific comments related to concerns that I have about the information provided. Many of the comments are minor, and focus on editorial issues or material presentation. More substantive comments and questions are provided in the sections relating to fisheries ecology and management (my areas of research experience).

I begin with an overview of the entire document and attempt to address the questions asked in the “request for expert assistance”. However, more detailed comments are provided on a chapter-by-chapter basis.

General review of entire document:

Here I attempt to address the questions listed in the “Request for Expert Assistance” for the document in its entirety:

1. Does the MFL document present a defensible scientific basis for setting initial minimum flows and levels within this water resource? Are the approaches or concepts described in the document scientifically sound based on “best available information?”. *In general, I would conclude that the document indeed presents a reasonable argument for establishing the MFL criteria proposed. I do, however, have a few primary concerns.*

A. The main area of concern I have relates to fisheries issues. As documented on a chapter-by-chapter basis below, I believe that there is simply not enough information provided to thoroughly assess the potential impacts of the proposed water-management strategies on fish populations and communities. There are a number of things that aren't particularly clear in the report, including 1) what data have actually been quantified and for what populations, 2) what were the spatial and temporal components of the data collections, 3) what attempts (if any) have been made to quantify data for non-game fish species, 4) when and how were angler surveys conducted, 5) what (specifically) monitoring strategies will be used going forward to determine the influence of the water-management plan on fish populations and communities? I believe this information is fundamentally important in the evaluation of the MFL document in relation to the potential influence of the proposed water-management strategies on fish populations and communities. This issue relates both to “scientific defensibility” and “best available information”. To consider the proposals scientifically defensible, the document should clearly establish what fish data are available, how and when they were collected and analyzed, and what will be monitored going forward.

With that in mind, I make three recommendations. First, I recommend that the authors

go back to the Florida game and fish commission and make sure that all available data are included in the proposal. Second, I suggest that the authors draw on relevant literature to document the ways in which similar water-management strategies might influence fish populations and communities. This should be easy to do given the availability of studies conducted on similar systems in Florida (in particular, the authors should consult work done by Dr. Mike Allen of the University of Florida) and elsewhere (I have included some additional citations in the chapter-by-chapter summary below). Finally, I suggest that the authors carefully document what monitoring protocol should be developed as the project moves forward. In particular, I would suggest that the authors monitor size-specific abundance and distribution of important game and non-game fishes in Lake Istokpoga. It is also important that these data are collected in a way that minimizes bias (e.g., electrofishing, seining, etc.) rather than through angler surveys. Although angler surveys may provide good supplemental data, they are too biased and limited to serve as the backbone for analyses on the status of fisheries in the lake.

As one small caveat, I would point out that I commend the authors for generally taking an ecosystem-level approach to considering the impacts of these water-management strategies, and I certainly recognize that occasional tactics that may cause short-term harm to fisheries resources may ultimately translate into a net benefit for the system.

B. Another concern relates to the argument made for not including water quality considerations in the MFL decision. Although I believe it may be fair to argue that water-quality data are inadequate, I don't think the arguments and assumptions, as stated, are scientifically defensible. I think that there is likely to be a strong link between water level and water quality, particularly in relation to nutrient inputs. I think better support for this argument is necessary, along with, perhaps, inclusion of a discussion of and/or references for the "alternative stable states" hypothesis or other primary ecological theory related to nutrients, the dynamics of macrophyte-algal interactions, and associated influences on water quality (e.g., Hargeby et al. 2004). As well, there may be system-specific reasons that these water-quality/water-level relationships exist. Regardless, those should be more clearly documented in the proposal so that the reader clearly understands the assumptions your MFL rests upon.

C. Finally, I wonder about the importance the authors place on the data from the 2001 drawdown. In a number of cases, they suggest a generally positive outcome on floral and faunal communities in the ecosystem. However, because many of the species present are long-lived and have long generation times, I'm not certain that it is scientifically defensible to use this recent drawdown as a foundation for comparison, particularly in the context of recommending future drawdowns. It would seem that much longer-term collections would be necessary to adequately assess the influence of that drawdown on the ecology of the system and its inhabitants. Although I don't necessarily recommend excluding the discussion of the drawdown itself (and perhaps the data collected thus far), I do think the authors tend to overstate the positives when the actual impact of the 2001 drawdown may not yet be fully recognized (and even the presumed short-term benefits may not yet be completely understood). I think there needs to be more discussion of the limitations of the data collected so far and a better consideration of some of the potential drawbacks associated with similar events in the future. I don't believe that referencing this one-time, relatively recent drawdown, necessarily presents a defensible argument for recommending similar strategies in upcoming years. I recommend a more balanced treatment of the 2001 drawdown, including some consideration of the possibility that negative impacts have not yet

been quantified due to the short time frame or inadequate data collections. In particular, the authors should reference work by Dr. Mike Allen on the potential negative influences of drawdowns on fish spawning and recruitment.

2. Are the proposed criteria logically supported by “best available information” presented in the main body of the document? What specific additions, deletions or changes are recommended by the expert to enhance the validity of the document? *As indicated in my answer to question one, I do not believe that the authors have supported their fisheries-related concerns with the best available information. This can be solved in two ways. First, they should be explicit about what data currently exist regarding fish populations and communities in Lake Istokpoga (particularly associated with the drawdown event in 2001), and make sure that all available (relevant) data are included in the proposal so that the potential impacts of the MFL can be adequately assessed. Second, they should cite current literature related to the influence of water-management strategies and water-level drawdowns on fish populations and communities. As indicated above, there are a number of good sources on systems similar to Lake Istokpoga that could be used for reference.*

3. Are there other approaches to setting the criteria that should be considered? Is there available information that has not been considered by the authors? If so, please identify specific alternatives to setting the MFLs and the data available to validate the alternative approach. *I think that the approach the authors used was adequate and logical. As indicated in my response to questions one and two, I do think that there are instances in which their arguments might be strengthened by broadening the context to other systems (including, if possible, some outside of the state). I have made some specific reference suggestions in the sections below. I don't believe that this would change the arguments made or the outcome of the decision. I do think, however, that it would strengthen the case they are making in certain instances. This is particularly true in the areas of general ecological and fisheries theory (e.g., water quality, influence of water-level fluctuations on fish habitat and fisheries), which are not system-specific concerns.*

Chapter summaries and comments:

I. Executive Summary:

A. Background Information: The executive summary concisely documents background information on the Lake Istokpoga ecosystem and details plans associated with its management. The major points of importance covered in the executive summary included:

- Lake managed for flood prevention, recreation, fish/wildlife habitat, and water supply
- New water diversions have changed the ecology of the watershed
- Definition of significant harm, and references Chapter 373 for water resource functions
- Identification of valued ecosystem components (wetlands and fisheries)
- MFL criteria: 36.5 NGVD for 20+weeks, greater than every 4 years.

B. Questions and Comments:

1. Bottom pg. iii: Assuming the discussion of patterns of drying and flooding is refers to a natural flood pulse? Some additional discussion of the ecological importance of flood pulses here or elsewhere would be useful for the reader.

2. A detailed definition of NGVD would be useful here for readers unfamiliar with this measurement.
3. Here (and throughout document): when the NGVD is referenced, how is water level measured? I assume this is a mean water level, but it's not clear at this point how and where those water levels are taken.

II. Chapter 1:

A. Background Information:

- Water management districts annually review priority list schedules and make revisions
- MFLs are not stand-alone tools, but part of larger resource protection responsibilities.
- Outline of specific factors to consider in setting MFL
- Need for establishment of resource functions for protection and identification of baseline conditions.
- Definitions of "harm".
- Water shortages and phases of restrictions (1 & 2 = prevent harm. 3 & 4 require use cutbacks that may cause economic impact).
- Provision for development of a recovery and prevention strategy if MFL is violated.

B. Questions and comments:

1. Middle paragraph on page 3: could this be restructured to make less confusing? There is a reference to minimum flow and then minimum level, but it's not clear how these are related (i.e., if the flow is low is the level also low? Can you have one without the other?).
2. Top of page 4: the phrase "natural seasonal changes in water flows or levels" is used. Does this refer to a natural flood pulse (or something similar) that apparently no longer exists in Lake Istokpoga? If so, is there some desire to restore this (despite the fact that the documentation makes clear that these plans are not designed for restorative purposes)?

III. Chapter 2:

A. Background Information:

- Provides detailed background information on Lake Istokpoga itself, the water control structures, the climate, the land use and hydrology, the biological resources, water quality issues, water resource issues, and other projects associated with the management of Lake Istokpoga and the surrounding watershed.

B. Questions and comments:

1. Pages 13-14: I'm having a difficult time visualizing the physiography of the region. Is there any way that this could be presented graphically?
2. Figure 9 is poor and difficult to interpret. If this figure is necessary, it should be revised.
3. Top of page 22: The description of the FAS needs to be more clear. Without detailed understanding of the area and of aquifer systems, it is very difficult to follow this description.
4. Bottom of page 24: The relationship between stage and area for the lake is described as "almost linear". My view of this relationship would be that it is asymptotic.
5. Page 25: Elevations are now discussed in terms of sea level rather than NGVD used earlier. More consistency would make the document easier to read and interpret.

6. Page 28: Describes a 12-year period of record. Should this not be an 11-year period?
7. Page 29: How was evapotranspiration estimated?
8. Page 35: At the bottom, a large-scale vegetation management and treatment project is referred to, but there is no additional supporting information. I would recommend including, at this first mention, a detailed description of the Floridone treatment mentioned later in this chapter (e.g., what is Floridone, how was it applied, what effects might be recognized beyond just aquatic vegetation removal, etc.).
10. Page 38: How were the surveys of fish populations and communities conducted? When? By whom? The same questions apply to the angler surveys. Much more information is needed here (and in other chapters when referring to fisheries data) to gain an accurate understanding of the fisheries-related issues in Lake Istokpoga [see additional comments in upcoming chapters].
11. Page 43: Is there no TDML for Lake Istokpoga? If not, why not? If so, some information should be provided here.
12. Page 52: What is the source of the mercury?
13. Page 56: The description of pools in the Kissimmee River would be easier to follow if there was a map or graphical illustration to reference.
14. Section on Lake Istokpoga Resource Protection Programs: This is valuable information for the reader. It is good to know how the current plan fits with existing management plans and initiatives for the lake and surrounding ecosystems. However, it's not clear from reading this how these all fit together (e.g., what is the level of cooperation and coordination among projects in terms of working towards a common goal? Is there data sharing or leveraging of ideas among projects?...etc.). Would it be possible to provide additional summary information that discusses how these projects all fit together to address watershed issues throughout the region?

IV. Chapter 3:

A. Background information:

- Water resource functions: supply, flood control, quality, habitat, and recreation.
 - primary goals are flood protection and water supply.
- Water quality issues – better in wetlands, worse in tributaries (especially nutrients).
- Hydrological changes (Alterations of hydro patterns, reduced water tables and wetlands, drainage and diversion, alteration of water courses, construction of ditches and canals, changes to seasonal flood patterns).
- Discussion of considerations (Natural systems, hydrology, water supply, flood protection, water quality, navigation and recreation).
- Discussions of exclusions (no Section 373 exclusions).

B. Questions and comments:

1. Page 59: Water storage is mentioned under “water supply and flood control”. This is very general and vague; some additional discussion (and quantification, if possible) would be useful. For example, how much storage is possible? What parameters are used to determine when water is stored or passed? Are these seasonal or day-to-day decisions?
2. Page 60: Under the “water quality” subsection, the low water quality of tributary inflows is mentioned. Is there any effort to address or remedy this problem (related primarily to agriculture – tillage, tiles, alternate fertilizers, etc.)?

3. Page 61, top: The way the first paragraph reads implies that the undeveloped creeks and lakes are not important wildlife habitat. It would seem that these areas could be as or more important than the “remaining water bodies and wetlands” described in the following sentence. Should this be revised, or is there some reason that the creeks and lakes are not as valuable as they would seem to be?
4. Page 61: Small semantic issue: the term “fishery” is used. This term implies a human-use component that would not be appropriate when describing a fish communities’ importance to wildlife issues in general. The terms “fishery” and “fisheries” should be reserved for discussions of fish populations or communities subject to harvest by anglers.
5. The “Considerations” section: In my opinion, this section should be modified to include a separate subsection for fish and wildlife issues. Although these are mentioned briefly within the subsection “natural systems”, the current presentation fails to reflect the ways in which fish and wildlife issues are biologically and ecologically connected to each of the other subcategories listed. That is, fish and wildlife issues are influenced by hydrology, water supply, flood protection, water quality, and recreation. Therefore, these seem to warrant a separate subcategory that acknowledges their importance and the necessity of considering their links to each of the other areas of consideration.
6. There is a typographical error on the top of page 64 (second sentence should read “The construction of numerous....” rather than “The construction of *a* numerous....”).

V. Chapter 4:

A. Background information:

- Provides conceptual basis for MFL (minimum flow is only one component, need for best available information, etc.).
- Listing of notable changes to system in previous century (Stabilization of water levels, alteration of seasonal patterns, alteration of flowways, draining of floodplain, nutrient pollution, nonnative plants, organic sediment accumulation).
- Listing of management objectives (provide periodic drawdowns to approximate low water conditions, provide a more natural pattern of seasonal water levels, protect and enhance wetlands, improve water quality).
- Identification of other programs in Florida lakes.
- Identification of historic hydrological conditions.

B. Questions and comments:

1. Page 67: The “adaptive approach” to management mentioned in this section is to be commended, however, additional information would be useful. For example, when are evaluations and changes going to take place? What are the logistics associated with making changes if they are deemed necessary?
2. I am surprised by (and have some concerns regarding) the management objectives for Lake Istokpoga described on page 68. In particular, I’m surprised by objective 1 (“Provide periodic drawdowns....”). Although this seems like an important consideration, the timing and implementation of these drawdowns could have serious impacts on the other important issues mentioned throughout the document (water levels, fish and wildlife habitat, consumptive use, etc.). In particular, I have concerns about drawdowns and their potential impact on fish communities. Spawning and habitat use by important recreational (e.g., largemouth bass, bluegill, and crappie) and non-game species could be

influenced to a significant degree by the number, timing, and duration of drawdown events. If these were implemented, I would recommend providing far more detail about the logistics of the drawdowns and a careful consideration of the potential impacts on fishery resources. Literature is available, in particular, on the influence of reservoir drawdowns on largemouth bass spawning, movement, and behavior, and this and other similar literature should likely be consulted (e.g., Kohler et al. 1995; DiCenzo et al. 1995; Rogers and Bergersen 1995; Raibley et al. 1997). Although the authors seem to be encouraged by fishery data following the earlier drawdown, I would suggest that it may be too early to determine the actual impact of that drawdown on the ecology of the system and the associated fish populations and communities. In addition, because only limited information is provided on how the fishery surveys were conducted, it is difficult to determine whether the data are a reliable indicator of the actual condition of the fisheries.

2. Page 69: Lake Okeechobee has significant aquatic habitat loss when water level decreases by only 1 foot. Could this present a similar problem in Lake Istokpoga? The reader is left wondering.
3. Page 73: Although the categories defined by the SJRWMD are somewhat semantically confusing, I really like the definition of different stages. This makes good sense ecologically. Was there any effort to develop a similar stage strategy for Lake Istokpoga? Would that approach not be valuable in Lake Istokpoga?
4. Page 74: Indicates that descriptive statistics were used to characterize the three water regime periods. Were those analyses adequate to answer the background questions you asked? Was there any feeling that additional “hard” statistical tests would be useful to actually quantify the differences among periods?
5. Page 76: Describes water supply issues and makes clear that water supply has been and may become a significant problem. If that is the case, why are additional drawdowns being considered? When would these drawdowns occur, and how would they impact the water supply issues addressed in this section? I find it interesting that the following statement is made at the bottom of page 76, “Lake Istokpoga’s water supply function is therefore not considered a constraint in developing MFL criteria at this time”. That seems to be contrary to previous statements that water supply has been and could continue to be a concern.
6. Water quality and lake levels, pages 77-78. I find it difficult to believe that there is a weak relationship between water levels and water quality. Although I agree that the “magnitude of these inputs to the lake is independent of water levels in Lake Istokpoga...”, this assumption fails to recognize that water level and water quality are likely inextricably linked. For example, the influence of nutrient inputs into the lake would presumably be quite different when water levels are low versus high, which would effect, among other things, the presence and persistence of macrophytes and algae (and the dynamics between the two), sunlight penetration and turbidity, and nutrient concentration. This, in turn, would influence the fish and invertebrates present, and could establish a feedback loop through nutrient recycling by certain fish (e.g., nutrient recycling by gizzard shad; Mather et al. 1995; Vanni and Layne 1997). Thus, it would seem that the timing of water-level fluctuations and they way in which they interact with seasonal nutrient fluctuations would have the potential to influence the entire ecosystem. It may be that there is not enough information on water quality to include it in the

development of the MFL, but I would argue that the scientific assumptions leading to this decision are either incorrect or incomplete. I suggest that a more careful consideration of the potential relationship between water level and water quality be considered and described, even if the ultimate conclusion is that there is insufficient information to include it in the development of the MFL at this time.

7. Page 78: It is interesting that the chemical vegetation control resulted in an increase in chlorophyll *a* but not in algal blooms. Algae presumably increased substantially following the removal of macrophytes, and this would explain the chlorophyll *a* increase. Were these data quantified correctly? Perhaps some additional discussion could be provided here. In addition, the literature on “alternative stable states” (e.g, Janse 1997) and macrophyte-algae dynamics could be consulted and used as context for these considerations if similar future vegetation treatments are planned.
8. Page 79, Fish communities: As stated several times before, I find the information presented on fish communities inadequate to fully evaluate. This section states, “the effects of low water levels on the fishery resource were considered as part of the MFL criteria. Fish survey data, collected before and after the 2001 drawdown, and the impact of low water levels on critical habitats were examined to determine whether impacts occurred that persisted for more than two years.” Much more information is necessary. For example:
 1. What effects were considered?
 2. Which fisheries? Just largemouth bass, crappie, and bluegill? If so, what about important forage fish that influence each of the three sportfish?
 3. How were the data collected?
 4. What impacts were measured and how were they quantified?
 5. What temporal component allowed determination of impacts that persisted for more than two years?In addition, I’m wondering about continued surveys. Will additional data be collected? It may be that effects of the drawdown will be more long-term, and may not show up for many years. This would be particularly true if the drawdown had an effect on forage fish populations, or on life-history characteristics of the sportfish (timing of maturation, age-at-first maturation, mortality schedule). Simple population parameters like measures of recruitment and size structure may not be adequate to determine the future dynamics of these fish populations and communities.

VI. Chapter 5:

A. Background information:

- Provides historical context for understanding hydrology of Lake Istokpoga.
- Points out ecological value of both high and low water events.
- Provides table (table 14) that summarizes access status at different water levels.
- Summarizes water level requirements for wetlands.
- Summarizes analysis and recommendations

B. Questions and comments:

1. Last two paragraphs on page 89: The 2001 drawdown was only a few years ago. I’m wondering if there has really been time to assess the impact of that drawdown on a swamp community, which contains flora with much longer life spans and generation times. Are there plans for continued monitoring? The same question applies to the

interpretation of data on the marsh community – is it too soon to say that the drawdown event was actually beneficial?

2. Table 15 – was any literature for systems outside of Florida consulted? Is this a comprehensive enough search to get adequate information for decision-making purposes?
3. Section on water level requirements of fish communities: Similar to comments on previous fishery-related issues, I still feel that more information is needed to adequately assess the influence of water-level management on fish populations and communities. For example:
 - What does “enhancement of fish habitats” mean? Because habitat requirements for different species are so variable, enhancement for one species may be detrimental for others.
 - The text suggests that the water drawdown caused a temporary reduction in numbers of some fish species, but that those quickly rebounded. How were these data quantified? What other factors were considered? My concern is that, just because numbers are returning to pre-drawdown levels doesn’t necessarily mean that the impact on the population(s) is well understood. When population density rapidly declines, it is often the case that fish will reproduce at younger ages and smaller sizes, which will, through time, result in a change in the age and size structure of the population. This is particularly important to consider with predatory fish like largemouth bass and crappie, which undergo ontogenetic diet shifts. The timing of their switch to piscivory can have a marked influence on other fish populations (e.g., bluegill) and can, therefore, really affect the entire aquatic community.
 - I think it’s too soon to say that significant harm was not documented. Again, we need to know what metrics were quantified, and we have to determine how long it might actually take to better understand the influence the drawdown may have had..
 - The text suggests that water-level drawdowns below 36.5 feet may reduce littoral zone habitats. I’m wondering if this is really a concern. It would seem that, in a lake that is only 4 ft deep on average, most of the lake would be littoral zone.
 - Top of page 92 – suggests that the change in water levels could reduce the quality of fish habitats and reduce spawning success. Again, this is difficult to interpret based on what is presented. The dynamics of fish populations are tied to so much more than spawning success that this seems difficult to defend without more detail. In some cases, reduced spawning success can be quite beneficial to fish populations. For example, reductions in spawning might help alleviate density-dependent growth limitations or recruitment bottlenecks. As such, a more detailed discussion of data collection procedures (past and future) is necessary to really understand and assess the influence of water-management initiatives on fish populations and fisheries.

VII. Chapter 6:

A. Background information:

- Defined significant harm as occurring when water levels fall below 36.5 feet NGVD for 20 weeks or longer, more frequently than every four years.
- Describes rationale for proposed criteria in terms of fisheries resources.
- Goes over monitoring, prevention, and research recommendations.

B. Questions and comments:

1. It’s interesting to me that the rationale for proposed criteria focus almost exclusively on

fisheries issues. Throughout the document, much more detail was provided on other aspects of Lake Istokpoga (e.g., hydrology, recreation, flood control, water supply, etc.). It's encouraging that fisheries considerations are so important, but I feel that more information is needed in the previous sections to better assess the potential impacts of water-level management on fish populations and communities.

2. Page 100: suggests that the FWC conducts annual fish catch surveys. Are there other data collections on fish populations and communities? Catch data can be notoriously unreliable, and samples only a few members of the fish community (and only a small fraction of the populations actually being harvested). I recommend that, if much of this water-management plan is built with fisheries issues in mind, a more rigorous sampling protocol be developed. Or, if more data have been and will be collected, that should be clearly described in this documentation so that it possible to assess the adequacy of those data collections to meet the needs of management-related goals.
3. On page 101, the 'Research Recommendations' section states that "birds, fish, aquatic and littoral zone communities are being monitored, as well as water quality...". This seems to conflict with the statement on page 100 (which says that no additional biological monitoring of parameters in Lake Istokpoga are proposed). More importantly, I don't think there is enough information to adequately assess the monitoring strategies. For example, how are the fish populations and communities monitored? When? By whom? What data are collected? This continues the theme of 'more information needed' to adequately critique the MFL as it relates to fisheries and fish populations and communities.

VIII. Appendices:

1. *Appendix A*: My only comment on this appendix is that it probably contains more material than is actually necessary. I think the statute information is valuable. I'm not sure that all of the letters and documentation associated with the tribal compacts, etc. are necessary (despite the fact that they are relevant to the MFL document).
2. *Appendix C*: Contains useful information. Figure C-1 is difficult to interpret. Table C-3 may not be necessary.
3. *Appendix D*: Contains useful information. It is a bit difficult to determine how the calculations are influenced by "unknown" or "unmeasured" sources of water input and output, and how much the MFL depends on these calculations. Over long-term averages, however, the data seem fairly reliable and the approach seems scientifically sound based on the data that are available.

Literature cited:

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